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IS 5428-1 (1985): Specification for Gauge Glasses, Part 1: Tubular Glasses for Level Gauges [MED 17: Chemical Engineering Plants and Related Equipment]

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Indian Standard

(Reaffirmed 2006)

SPECIFICATION FOR GAUGE GLASSES

PART 1 TUBULAR GLASSES FOR LEVEL GAUGES

(First Revision)

1. Scope — Covers the dimensions, quality, material and requirements of tubular glasses for level gauges.

2. Definitions

2.1 *Annealed Glass* — Glass which has had objectionable stresses removed by controlled heating and cooling.

2.2 *Toughened Glass* (*Heat Treated Glass, Tempered Glass, Hardened Glass*) — Glass, the surface of which has been rapidly cooled from near its softening point, so that after cooling a residual compressive stress remains in the surface and is balanced by tensile stress below the surface. This increases the mechanical strength and thermal shock resistance of the glass and also, when it breaks, causes it to shatter into smaller and less angular fragments than an annealed glass.

2.3 *'As Drawn' Glass* — Glass tubing in the 'as made state, not having been furnace annealed, and containing certain desirable residual stresses, in particular compression stress in the outer surface.

2.4 *'Soda-lime' Glass* — Glass in which the main constituents are silica, soda and lime. Soda-lime glass has a relatively high coefficient of expansion and hence in the annealed state has only little resistance to thermal shock but its strength and thermal resistance can be greatly increased by toughening.

2.5 *Borosilicate Glass* — Silicate glass containing boron as a characteristic constituent. Borosilicate glass has a relatively low co-efficient of expansion and hence has considerable resistance to thermal shock. Because it has a low co-efficient of expansion, it does not develop as much stress as soda-lime glass under comparable toughening treatment. Because of its higher softening temperature, borosilicate glass withstands higher duty temperatures than does soda-lime glass without de-toughening. Because it has more resistance to corrosion than soda-lime glass, borosilicate glass is recommended for all reflex glasses.

2.6 *Defects* — Defects that may occur in glass and affect its performance.

2.7 *Corrosion* — Chemical and mechanical attack of glass surface by the contents of the pressure vessel.

Note — Owing to the difficulty of distinguishing corrosion and erosion as separate processes, the term corrosion is used to cover both processes.

3. Dimensions

3.1 Diameters and wall thicknesses of tubular glasses shall be as specified in Table 1. There shall be two grades with designation 'selected grade' and 'ordinary grade'. The three sizes given in Table 1 are with two different tolerances on diameter for these grades.

3.2 The length of tubular glasses are determined by the design of the fittings into which they are assembled. For steaming applications, such fittings shall not be more than 505 mm apart if the glass is unsupported or 600 mm apart if an intermediate support is used. For non-steaming applications, the corresponding distances shall be 1 000 and 1 200 mm respectively.

3.3 Unless otherwise agreed to between the purchaser and the manufacturer, the tolerance on length shall be ±2·0 mm.

4. Material

4.1 Tubular glasses shall be made of borosilicate glass. It is recommended that for steaming conditions tubular glasses shall not be be used above 1 850 kPa. For non-steaming conditions higher

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pressures are allowable up to a limit of 3 000 kPa. Tubing used for steaming conditions shall be in the 'as drawn' state and not annealed. Tubing used for non-steaming conditions may be 'as drawn' or annealed.

TABLE 1 DIAMETERS, THICKNESSES AND TOLERANCES OF TUBULAR GLASSES

(*Clause* 3.1)

All dimensions in millimetres.

Nominal External Diameter	Tolerance on External Diameter		Wall Thickness
	Selection grade	Ordinary grade	
13 16 19	+ 0 − 0·8	+ 0·4 − 0·8	1·8 to 2·5 2·6 to 3·3 2·8 to 3·5

4.2 The following properties shall be decided between the purchaser and the manufacturer depending on working conditions and shall be specified along with requisitions:

a) Chemical resistance to water, and alkalis with some minimum limits;

b) Average co-efficient of thermal expansion;

c) Chemical composition of glass; and

d) Tensile and bending strength at ambient and maximum operating temperature.

5. Finish of Ends

5.1 The ends of tubular gauge glasses shall be cut at right angles to the axis, then fused and flame cooled to prevent severe ring stress.

6. Straightness

6.1 Tubular glasses shall be straight within limits as agreed to between the purchaser and the manufacturer.

7. Ovality

7.1 The maximum and minimum external diameters of any cross-section at right angles to the axis of tubular glasses shall not differ by more than 3 percent of the nominal diameter.

8. Tests

8.1 *Dimensional Check* — The tubular glasses shall be checked for conformity to specified dimensions.

8.2 *Examination* — All glasses shall be examined with unaided vision (other than spectacles, if worn) after subjecting them to the test described in **8.4**. A glass is deemed to pass the thermal shock test if it shows no signs of damage, cracks, surface cracks, sealing or other defects.

8.3 *Thermal Shock Requirements* — The manufacturer shall certify that tubular glasses for steaming conditions will pass the thermal shock test. Glasses subjected to the test shall be destroyed after the test to prevent them being inadvertently put into service.

8.4 *Thermal Shock Test*

8.4.1 *Apparatus*

8.4.1.1 Cold bath for use with water capacity at least 4·5 litres (or for large articles, at least 10 litres for each 1 kg mass of glass), maintained at a temperature t_2 (20 ± 1°C) and provided with means of agitation and a thermometer graduated at each 1°C.

8.4.1.2 Hot bath for use with oil (up to 180°C) or air oven. Each shall be provided with means of agitation and of maintaining the temperature, t_1 (180°C ± 1°C) uniform and constant to 1°C.

8.4.2 The samples selected shall be placed in the hot bath and maintained at the temperature t_1 for 15 minutes. The articles shall be taken one at a time and plunged into the cold bath maintained at temperature t_2.

8.4.2.1 Tubular glasses shall enter the water vertically.

8.5 *Hydrostatic Test* — The level gauge assembly shall be hydrotested at a minimum pressure of 1·5 × Operating pressure × Allowable stress of glass at ambient temperature/Allowable stress of glass at operating temperature.

9. Sampling — Two percent of the glasses (but not less than 10 or more than 30 glasses) shall be taken by random selection from each consignment of tubular glasses. If more than 10 percent but not more than 20 percent of the glasses in the sample fail, a further sample of 2 percent (but not less than 10 or more than 30 glasses) shall be taken by random selection and subjected to a second test. If not more than 10 percent of the second sample fail the test, then the consignment is deemed to comply the standard.

10. Designation — The tubular gauge glass 16 mm in diameter and 250 mm length shall be designated as:

Gauge Glass T 16 × 250 IS : 5428(Part 1)

11. Marking — The gauge glasses shall be permanently marked with the following:

a) Manufacturer's identification or trade-mark;

b) Designation of the gauge glass; and

c) Pressure-temperature rating (depending upon thickness used).

11.1 The marking shall not interfere with the function of the glass and preferably shall be placed so as to be visible when mounted.

11.2 *ISI Certification Marking* — Details available with the Indian Standards Institution.

12. Packing — The gauge glasses shall be packed securely in suitable inner boxes, containing not more than 100 gauge glasses and adequately cased for transport.

APPENDIX A

A-1. Effects of Temperature and Pressure — Limits of working pressure on tubular gauge glasses depend on freedom from stress induced by badly aligned fittings, the length of glass, and the presence of any corrosive conditions. In steaming application, users should establish a permissible life, dependent on feed water and pressure conditions, which permits no more than half the tubular wall thickness to be corroded away in the area of the gauge cone or packing.

Tubular glasses for boilers, and for other vessels where conditions of pressure, temperature and corrosion are similar to those for boilers, should not be longer than 505 mm unsupported or 600 mm supported. For non-steaming conditions, lengths up to 1 000 mm unsupported and 1 200 mm supported may be used. Whare a gauge length above these limits is required, it should consist of a combination of shorter glasses.

A-2. Corrosion — Corrosion of glass on pressure vessels is sometimes a problem requiring consideration, because of the faster rate of chemical reactions at temperatures and pressures above atmospheric. Borosilicate glass is more resistant than soda-lime glass to attack by hot water and acids. Toughening does not increase the corrosion resistance of glass. For use under severe conditions, for instance in the presence of alkalis where the consequences of failure would be serious, the use of two glasses (each capable of withstanding the full pressure) is to be preferred. In boiler practice, the glass is frequently protected by mica alternatively, corrosion may be minimized by control of the fluid circulation. The glass manufacturer should be consulted regarding the possible effect of corrosion on the properties of glass for pressure vessels wherever particularly adverse conditions are likely to be encountered.

EXPLANATORY NOTE

This standard was originally published in 1969 in two parts. The present revision of the standards have been made as a result of further experience gained aud development in this field and has been brought out in five parts as follows:

Specification for gauge glasses: Part 1 Tubular glasses for level gauges [IS : 5428 (Part 1)-1985], Specification for gauge glasses: Part 2 Protector glasses for tubular gauges [IS : 5428 (Part 2)-1985],

Specification for gauge glasses: Part 3 Through-vision and reflex glasses [IS : 5428 (Part 4)-1985],

Specification for gauge glasses: Part 4 Circular sight and light glasses [IS : 5428 (Part 4)-1985], and

Specification for gauge glasses: Part 5 Port gauge glasses as used in fittings for steam boilers [first revision of IS : 5428 (Part 5)-1985].

In the preparation of this standard assistance had been derived from BS 3463-1975 'Observation and gauge glasses' for pressure vessels issued by British Standards Institution.

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